STATE OF SOUTH DAKOTA
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DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
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OPEN FILE REPORT 90-UR

Hydrogeologic Assessment of the High Plains Aquifer in Tripp and Gregory Counties, South Dakota

Dragan Filipovic

2004

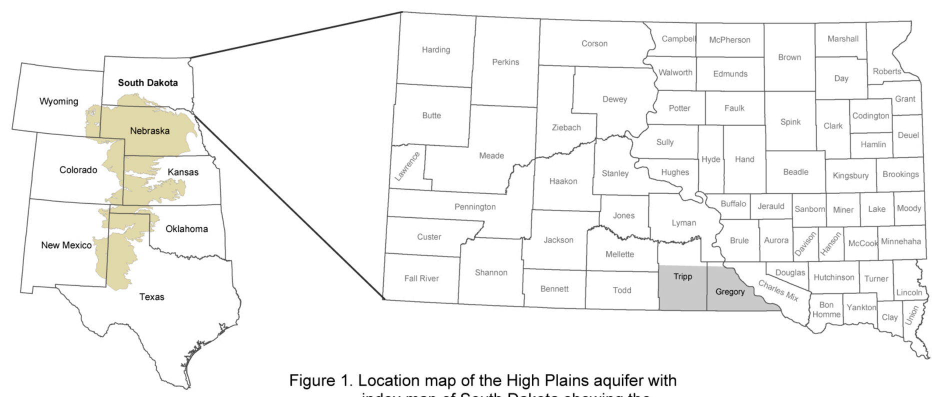


Figure 1. Location map of the High Plains aquifer with index map of South Dakota showing the study area in Tripp and Gregory Counties.

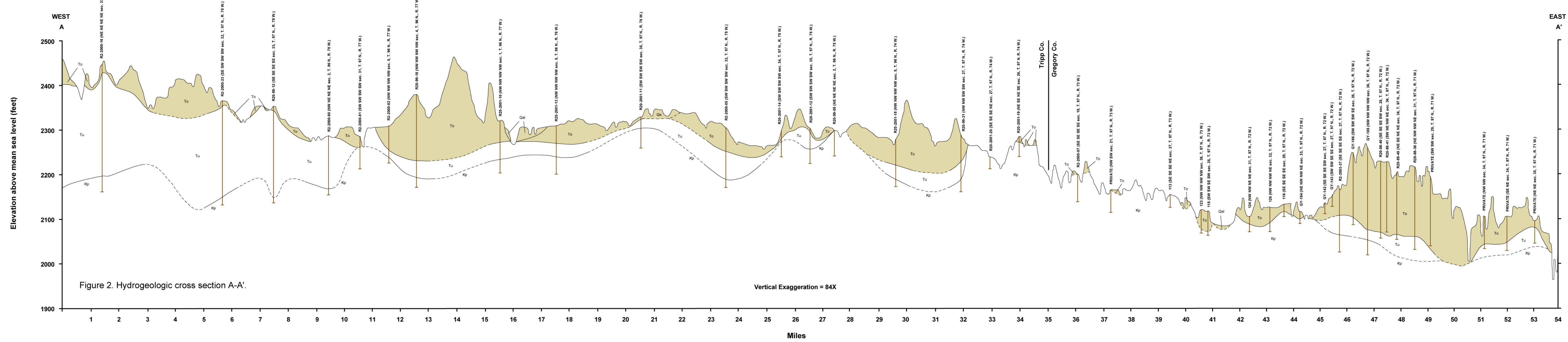


Figure 2. Hydrogeologic cross section A-A'.

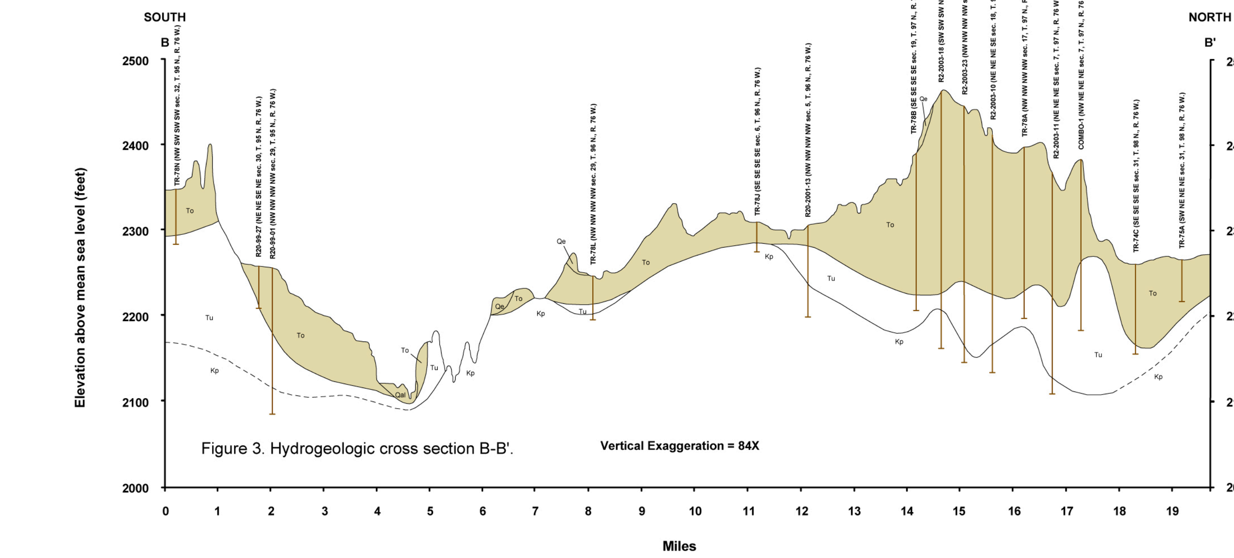
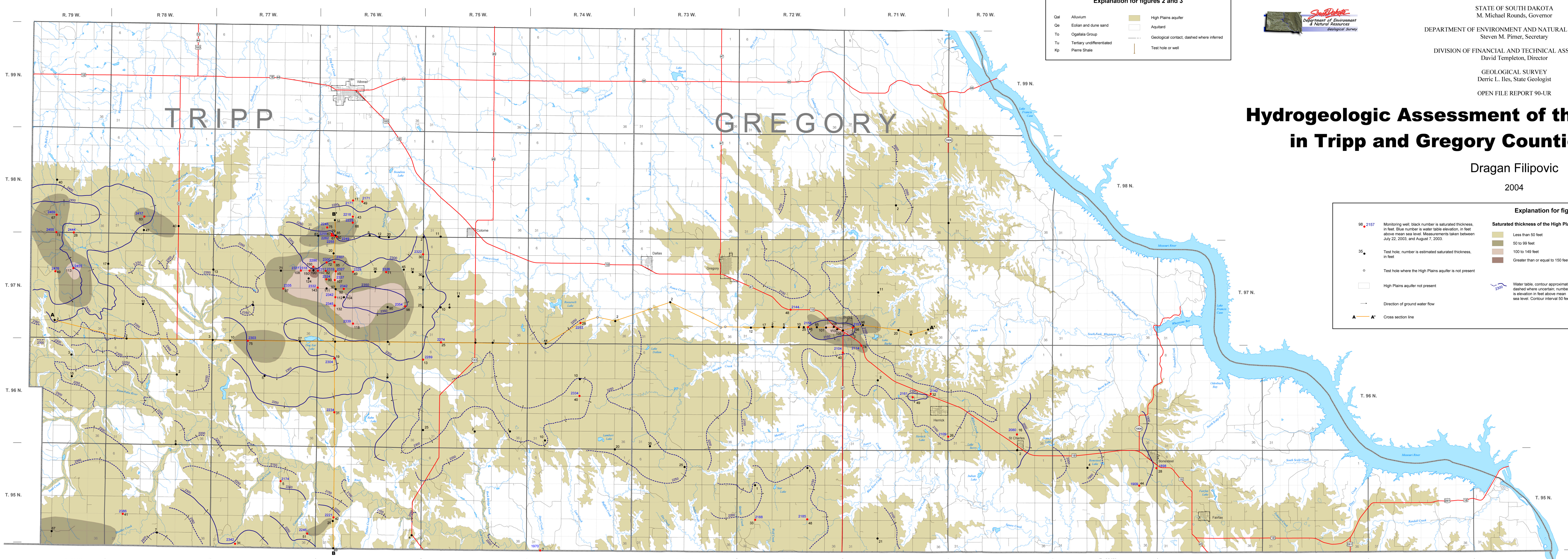


Figure 3. Hydrogeologic cross section B-B'.

Explanation for figures 2 and 3

Qal	Alluvium		High Plains aquifer
Qe	Eolian and dune sand		Aquitard
To	Ogallala Group		Geological contact, dashed where inferred
Tu	Tertiary undifferentiated		Test hole or well
Kp	Pierre Shale		

Figure 4. Areal extent, water table, and saturated thickness map of the High Plains aquifer in Tripp and Gregory Counties.



Scale 1:100,000

Explanation for figure 4

98 2157 — Monitoring well; black number is saturated thickness, in feet. Blue number is water table elevation, in feet above mean sea level. Measurements taken between July 22, 2003, and August 7, 2003.

35 — Test hole; number is estimated saturated thickness, in feet

Test hole where the High Plains aquifer is not present

High Plains aquifer not present

Direction of ground water flow

A — A' Cross section line

Saturated thickness of the High Plains aquifer

- Less than 50 feet
- 50 to 99 feet
- 100 to 149 feet
- Greater than or equal to 150 feet

2300 — Water table, contour approximate, dashed where uncertain; number is elevation in feet above mean sea level. Contour interval 50 feet.

Major road — Road — River or stream — Lake or large body of water — Slough or intermittent lake — State boundary — County boundary — Township boundary — Section boundary — City boundary

Table 1. Water level data in the High Plains aquifer in Tripp and Gregory Counties

Well name	Location	Casing top elevation	Water elevation and date of measurement[1] March 11-12, 2002	July 22-25, 2002	October 2-9, 2002	July 22 – August 7, 2003
GY-78C[2]	SE SE SE SE sec. 1, T. 95 N., R. 69 W.	1931	1901	1900	1899	1898
GY-78D[2]	NE NE NE NE sec. 14, T. 95 N., R. 69 W.	1944.5	1911	1910	1909	1909
R2-2003-27	SW SW SW SW sec. 20, T. 95 N., R. 72 W.	2287	---	---	---	2188
GY-78B[2]	SE SE SE SE sec. 22, T. 95 N., R. 72 W.	2218	2188	2187	2187	2185
TR-57C[2]	SW SW SE SE sec. 31, T. 95 N., R. 74 W.	1991	1973	1971	1971	1972
TR-78F[2]	NW NW NW NW sec. 29, T. 95 N., R. 76 W.	2254	2223	2222	2222	2221
TR-78N[2]	NW SW SW SW sec. 32, T. 95 N., R. 76 W.	2349.5	2342	2338	2337	2337
R2-2001-60	NW NW NW NW sec. 14, T. 95 N., R. 77 W.	2216	2176	2175	2175	2174
TR-78M[2]	SW SW SW SE sec. 25, T. 95 N., R. 77 W.	2289.2	2248	2247	2247	2246
TR-59B[2]	SE NE NE SW sec. 32, T. 95 N., R. 77 W.	2381	2344	2343	2342	2342
TR-78E[2]	SW SW SW SW sec. 20, T. 95 N., R. 78 W.	2430.1	2389	2387	2388	2386
R20-90-26	SW SW NW NW sec. 31, T. 96 N., R. 70 W.	2157	---	---	---	2109
GY-57B[2]	SE NE NE NE sec. 34, T. 96 N., R. 70 W.	2087.1	2081	2080	2080	2080
GY-78A[2]	NE NE NE NE sec. 6, T. 96 N., R. 71 W.	2166.2	2116	2115	2115	2114
R20-94-49	NW SW SW NW sec. 6, T. 96 N., R. 71 W.	2112	---	---	---	2104
GY-57A[2]	SW SW SW SW sec. 13, T. 96 N., R. 71 W.	2164.7	2142	2142	2142	2142
R20-90-20	SE SE SE SE sec. 15, T. 96 N., R. 71 W.	2175	---	---	---	2161
TR-79A[2]	SE SE SE SE sec. 16, T. 96 N., R. 74 W.	2343	2336	2334	2333	2334
TR-78K[2]	SW SW SW SW sec. 6, T. 96 N., R. 75 W.	2302.5	2291	2291	2290	2289
TR-78J[2]	SE SE SE SE sec. 6, T. 96 N., R. 76 W.	2310	2304	2303	2302	2304
TR-78L[2]	NW NW NW NW sec. 29, T. 96 N., R. 76 W.	2247	2238	2236	2235	2234
R20-99-18	NW NW NW NW sec. 4, T. 96 N., R. 77 W.	2377	2304	2303	2303	2303
R20-88-38	NE NW NW NE sec. 31, T. 97 N., R. 71 W.	2213.9	---	---	---	2157
GY-77A[2]	SE SE SE SE sec. 21, T. 97 N., R. 72 W.	2151.5	2146	2144	2144	2144
GY-77B[2]	SE SE SE SE sec. 27, T. 97 N., R. 72 W.	2164	2156	2155	2154	2154
R20-99-35	NW NW SW SW sec. 27, T. 97 N., R. 74 W.	2287	2255	2254	2253	2253
R2-2000-06	SW SW SW SW sec. 32, T. 97 N., R. 75 W.	2302	2278	2277	2276	2274
TR-78G[2]	SE SE SE SE sec. 1, T. 97 N., R. 76 W.	2342.5	2324	2323	2323	2322
TR-72E[2]	NW NW NW NW sec. 5, T. 97 N., R. 76 W.	2260.5	2253	---	2250	2249
R2-2003-12	NE NE NE SE sec. 7, T. 97 N., R. 76 W.	2372	---	---	---	2307
R2-2003-07	NW NW NW SE sec. 7, T. 97 N., R. 76 W.	2339	---	---	---	2300
TR-78H[2]	NE NW NE NE sec. 15, T. 97 N., R. 76 W.	2334	2329	2326	2326	2326
R20-2001-08	NW NW NW NW sec. 16, T. 97 N., R. 76 W.	2422	2329	2329	2328	2328
TR-78A[2]	NW NW NW NW sec. 17, T. 97 N., R. 76 W.	2400.5	2328	2328	2327	2327
R2-2003-05	SW SW SW NE sec. 18, T. 97 N., R. 76 W.	2436	---	---	---	2324
R2-2003-03	NE NW NW NW sec. 18, T. 97 N., R. 76 W.	2411	---	---	---	2319
R2-2003-16	SW SW SW SW sec. 18, T. 97 N., R. 76 W.	2456	---	---	---	2332
R2-2003-10	NE NE SE SE sec. 18, T. 97 N., R. 76 W.	2410	---	---	---	2337
TR-78B[2]	SE SE SE SE sec. 19, T. 97 N., R. 76 W.	2393	2346	2345	2345	2345
R2-2003-22	NE NE NE NW sec. 20, T. 97 N., R. 76 W.	2421	---	---	---	2342
R2-2003-19	SW SW SW NW sec. 20, T. 97 N., R. 76 W.	2465	---	---	---	2342
TR-78I[2]	SE SE SE SE sec. 23, T. 97 N., R. 76 W.	2363.5	2357	2355	2354	2354
R20-99-37	SW SW SW SW sec. 28, T. 97 N., R. 76 W.	2350	2340	2340	2339	2339
R20-92-27	NE NE SW SE sec. 12, T. 97 N., R. 77 W.	2331	---	---	---	2286
R20-92-30	SW SW SW SE sec. 12, T. 97 N., R. 77 W.	2355	---	---	---	2318
R20-92-29	SE SE SE SE sec. 12, T. 97 N., R. 77 W.	2367	---	---	---	2317
R2-2003-14	NW NW NW NW sec. 13, T. 97 N., R. 77 W.	2364	---	---	---	2327
TR-78C[2]	NW NW NW NW sec. 23, T. 97 N., R. 77 W.	2342.5	2337	2335	2334	2335
R2-2000-18	NW NW NW NW sec. 14, T. 97 N., R. 79 W.	2464	2456	2455	2454	2455
R2-2000-15	SE SE NE NE sec. 16, T. 97 N., R. 79 W.	2608	2476	2476	2476	2476
TR-72A[2]	SE SE SE SE sec. 20, T. 98 N., R. 76 W.	2235.51	2177	2176	2174	2171
TR-72B[2]	NE NE NE NW sec. 28, T. 98 N., R. 76 W.	2199.5	2172	2171	2171	2171
TR-72C[2]	NE SE SE SE sec. 29, T. 98 N., R. 76 W.	2235.2	---	2219	2217	2218
TR-74A[2]	SW SW NE sec. 31, T. 98 N., R. 76 W.	2259.1	2247	2245	2245	2245
TR-74F[2]	NW SW SW SE sec. 31, T. 98 N., R. 76 W.	2266	2258	2256	2256	2255
TR-74E[2]	SW SW SW SE sec. 31, T. 98 N., R. 76 W.	2278.7	2263	2263	2262	2262
TR-74D[2]	SE SE SW SE sec. 31, T. 98 N., R. 76 W.	2283	2260	2258	2257	2255
TR-72D[2]	SE SE NE NE sec. 32, T. 98 N., R. 76 W.	2235.1	---	2225	2224	2225
TR-73A[2]	SE SE NW NW sec. 33, T. 98 N., R. 76 W.	2234	---	2219	2219	2220
TR-78D[2]	NW NW NW NW sec. 33, T. 98 N., R. 78 W.	2432.5	2419	2418	2417	2417
R2-2000-12	NW NW NW NW sec. 34, T. 98 N., R. 79 W.	2524	2469	2469	2469	2469
R2-2000-04	SW SW SW SW sec. 34, T. 98 N., R. 79 W.	2495	2456	2456	2455	2455
R2-2000-20	SE SE SE SE sec. 34, T. 98 N., R. 79 W.	2495	2445	2445	2444	2444

[1] Water elevation and casing top elevation are in feet above mean sea level.

[2] Well measured and maintained by the Water Rights Program, Department of Environment and Natural Resources (DENR). All other wells measured and maintained by the Geological Survey Program, DENR.

Table 2. Water quality analyses from the High Plains aquifer in Tripp and Gregory Counties

Well name	Sample collection date	Location	Parameter and concentration[1] Calcium	Chloride	Magnesium	Potassium	Sodium	Sulfate	Bicarbonate	Carbonate	Iron	Manganese	Fluoride	Nitrate plus nitrite	Total dissolved solids	Hardness	Alkalinity, total	pH
R2-2000-15	4-29-2002	SE SE NE NE sec. 16, T. 97 N., R. 79 W.	46.3	<3	5.7	6.9	3.6	<10.0	174	0	<0.03	<0.02	0.26	0.5	204	139	143	7.83
R20-2001-08	4-29-2002	NW NW NW NW sec. 16, T. 97 N., R. 76 W.	53.0	<3	6.9	5.6	3.2	<10.0	193	0	<0.03	<0.02	0.27	0.8	224	161	158	7.69
R2-2000-06	4-29-2002	SW SW SW SW sec. 32, T. 97 N., R. 75 W.	87.9	6	2.7	5.6	4.0	<10.0	185	0	<0.03	<0.02	0.22	16.7	364	231	152	7.62
R20-99-18	4-29-2002	NW NW NW NW sec. 4, T. 96 N., R. 77 W.	36.2	<3	5.1	6.5	5.6	<10.0	139	0	<0.03	0.02	0.23	2.1	187	111	114	7.58
R20-99-37	4-29-2002	SW SW SW SW sec. 28, T. 97 N., R. 76 W.	59.6	<3	6.4	5.4	2.9	<10.0	203	0	<0.03	0.03	0.18	2.1	237	175	166	7.56
R20-94-50	5-6-2002	NW SW SW NW sec. 6, T. 96 N., R. 71 W.	70.8	5.0	9.4	6.7	12.6	<10.0	268	0	<0.03	<0.02	0.32	2.1	355	215	220	7.80
R20-94-40	5-6-2002	NW NW NW NW sec. 29, T. 95 N., R. 76 W.	57.7	<3.0	7.6	9.8	8.8	<10.0	188	0	<0.03	<0.02	0.22	10.3	306	175	154	7.83
R20-94-41	5-6-2002	NW NW NW NW sec. 29, T. 95 N., R. 76 W.	272	5.0	22.7	23.4	8.0	38.3	116	0	0.04	<0.02	0.08	179	1273	773	95	7.22
R20-94-38	5-7-2002	NW NW NW NW sec. 23, T. 97 N., R. 77 W.	16.2	<3.0	1.9	4.9	5.3	<10.0	61	0	<0.03	<0.02	0.31	1.6	142	48	50	6.84
R20-94-39	5-7-2002	NW NW NW NW sec. 23, T. 97 N., R. 77 W.	20.1	<3.0	3.6	9.3	10.2	<10.0	87	0	0.05	0.05	0.35	4.9	171	65	71	6.87
R2-2003-14	7-17-2003	NW NW NW NW sec. 13, T. 97 N., R. 77 W.	23.1	3	3.5	4.5	4.4	<10.0	100	0	0.03	<0.02	0.25	0.8	141	72	82	7.73
R2-2003-22	7-17-2003	NE NE NE NW sec. 20, T. 97 N., R. 76 W.	53.8	3	5.9	4.9	5.3	<10.0	200	0	<0.03	<0.02	0.21	0.9	233	149	164	7.52
R2-2003-12	7-18-2003	NE NE NE SE sec. 7, T. 97 N., R. 76 W.	55.5	<3	6.0	5.3	2.8	<10.0	206	0	0.05	<0.02	0.23	0.7	238	163	169	7.53
R2-2003-27	11-13-2003	SW SW SW SW sec. 20, T. 95 N., R. 72 W.	60.8	7	8.5	7.8	3.5	<10.0	221	0	1.24	0.02	0.25	1.2	250	76	181	7.37
SDDWS[2]			---	---	---	---	---	---	---	---	---	---	4.0	10	---	---	---	---

Well name	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Thallium	Gross alpha
R2-2000-15	<0.0004	0.002	0.0746	<0.0004	<0.0002	0.0078	0.0005	<0.0001	<0.0001	0.0023	<0.0005	<0.0001	2.4 ± 1.3
R20-2001-08	---	---	---	---	---	---	---	---	---	---	---	---	---
R2-2000-06	<0.0004	<0.001	0.0436	<0.0004	<0.0002	0.0096	0.0007	<0.0001	<0.0001	0.0032	0.0016	<0.0001	<0.3 ± 1.3
R20-99-18	---	---	---	---	---	---	---	---	---	---	---	---	---
R20-99-37	---	---	---	---	---	---	---	---	---	---	---	---	---
R20-94-50	---	---	---	---	---	---	---	---	---	---	---	---	---
R20-94-40	---	---	---	---	---	---	---	---	---	---	---	---	---
R20-94-41	---	---	---	---	---	---	---	---	---	---	---	---	---
R20-94-38	---	---	---	---	---	---	---	---	---	---	---	---	---
R20-94-39	---	---	---	---	---	---	---	---	---	---	---	---	---
R2-2003-14	<0.0004	0.004	0.0525	<0.0004	<0.0002	0.005	<0.00002	<0.0001	<0.0001	0.0008	<0.0005	<0.0001	<0.3 ± 0.7
R2-2003-22	<0.0004	0.002	0.108	<0.0004	<0.0002	0.0108	<0.0001	<0.0001	<0.0001	0.0014	0.0015	<0.0001	2.1 ± 1.6
R2-2003-12	<0.0004	0.003	0.113	<0.0004	<0.0002	0.010	<0.0001	<0.0001	<0.0001	0.0013	0.0012	<0.0001	2.6 ± 1.7
R2-2003-27	<0.0004	0.005	0.0369	<0.0004	<0.0002	0.0111	0.0005	0.0007	<0.0001	0.0031	0.0009	<0.0001	27.9 ± 5.0
SDDWS[2]	0.006	0.05	2	0.004	0.005	0.1	1.3	0.015	0.002	0.1	0.05	0.002	15

[1] All concentrations are in milligrams per liter with the exception of pH, which has no units, and gross alpha, which is expressed in picocuries per liter.

[2] South Dakota Drinking Water Standard; Administrative Rules of South Dakota, Chapter 74:04:05.

Figure 5. Hydrograph of wells TR-78A, TR-78E, and GY-78D.

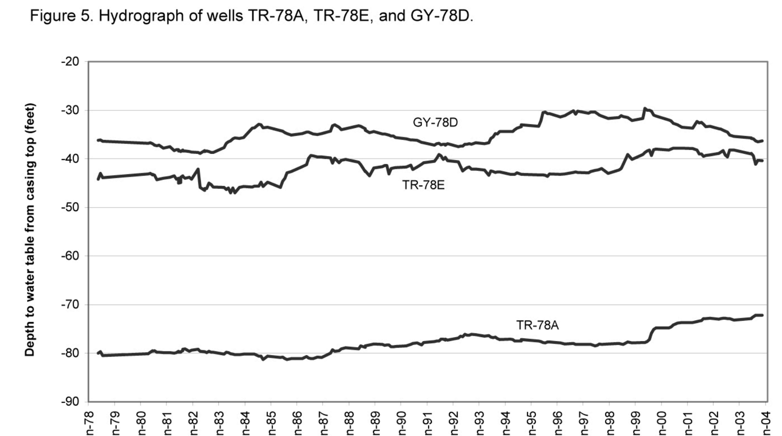
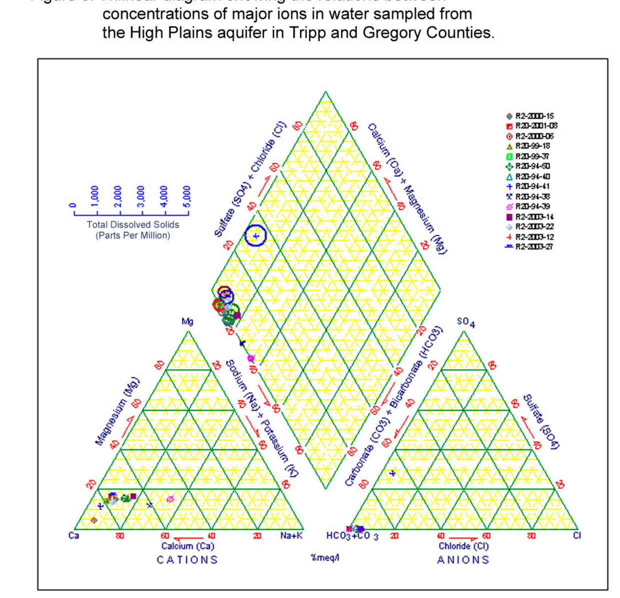


Figure 6. Trilinear diagram showing the relations between concentrations of major ions in water sampled from the High Plains aquifer in Tripp and Gregory Counties.



INTRODUCTION

This report was prepared to provide the results of an investigation of the High Plains aquifer in Tripp and Gregory Counties. The High Plains aquifer covers about 174,000 square miles of the central United States east of the Rocky Mountains in the Great Plains. Parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming are underlain by the High Plains aquifer as shown in figure 1 (Gutentag and others, 1984). The term "High Plains aquifer" is preferred to the "Ogallala aquifer" because Ogallala sediments constitute only one part of this ground water system.

Tripp and Gregory Counties, located in south-central South Dakota, have a combined area of 2,671 square miles. The High Plains aquifer covers an area of about 4,800 square miles in South Dakota, of which about 870 square miles lies within Tripp and Gregory Counties between 43°00' and 43°30' north latitude and 98°30' and 100°12' west longitude. Within this area, the aquifer is the principal source of water for irrigation, municipal, and domestic use.

Field work for this study began in May 1999 and continued through August 2003. The field work included the drilling of 126 test holes, 21 of which were completed as monitoring wells in the High Plains aquifer. Water samples were collected from nine wells for laboratory analysis.

METHODOLOGY

The general geology of the investigated area was determined using available geologic maps and lithologic log data, reviewing literature, and drilling and logging test holes. The following 1:62,500 scale geologic quadrangle maps were used: Witten (Schoon, 1958), Keyapaha (Schoon and Sevon, 1958), Winner (Collins, 1960), Wewela (Collins, 1958a), Dallas (Stevenson, 1959), Dixon (Baker, 1951), Gregory (Stevenson, 1958), Lucas (Baker and Carlson, 1951), Herrick (Baker and others, 1952), Bonesteel (Stevenson and Carlson, 1950), and Lake Andes (Stevenson and Carlson, 1951). In areas where 1:62,500 scale geologic maps were not available, the 1:500,000 scale Geologic Map of South Dakota (Martin and others, 2004) was used. Lithologic log data used in this study are on file at the South Dakota Geological Survey.

Water level data were collected from March 2002 through August 2003 from 21 of the monitoring wells installed in the High Plains aquifer for this study and from 42 other monitoring wells installed for previous studies. Water samples were collected for analysis of the general inorganic chemistry, trace metals, and radionuclides. The South Dakota Department of Health Laboratory completed the analyses.

PHYSIOGRAPHY AND CLIMATE

The study area is located within the Great Plains physiographic province. Flat to gently rolling terrain characterizes the High Plains region. This region is a remnant of a vast plain that was formed when streams flowing eastward from the Rocky Mountains deposited sediments across parts of the central United States. Subsequently, erosion isolated the plains from the mountains and formed escarpments that typically mark the boundary of the High Plains aquifer (Weeks and others, 1988). The plains slope eastward from about 2,600 feet in elevation at the western boundary of Tripp County to about 1,800 feet at the eastern boundary of the study area in Gregory County, indicating an average eastward slope of about 10 feet per mile.

The climate is typically continental, characterized by cold winters and hot summers. Average annual precipitation in Tripp and Gregory Counties from 1961 through 1990 was about 24 inches (High Plains Regional Climate Center, September 11, 2002). Mean annual evaporation in southern South Dakota as measured from class A evaporation pans is about 60 inches (Gutentag and others, 1984).

HIGH PLAINS AQUIFER

Geologic Description

In South Dakota, the High Plains aquifer consists of one or more hydraulically connected geologic units of late Tertiary or Quaternary age. In ascending order, the late Tertiary rocks consist of the White River Group, Arikaree Group, and Ogallala Group. The Quaternary sediments consist of alluvial and eolian deposits.

In south-central and southwestern South Dakota, the depositional surface during the Tertiary was composed of Cretaceous age Pierre Shale, which is a marine shale. The Pierre Shale is predominantly dark-gray to black throughout the study area; however, it is yellowish-brown to light-gray where weathered.

The White River Group, which was deposited during the Oligocene, underlies much of southern Tripp and southwestern Gregory Counties. Units of the White River Group in ascending order are the Chadron and Brule Formations. The following descriptions of the Chadron and Brule Formations were determined from results of this investigation and from Gutentag and others (1984). The Chadron Formation consists mainly of varicolored quartz sand and conglomerate interbedded with clay and silt deposited in channels. Because this formation is a channel deposit, it is only locally present in the study area. The Brule Formation is predominantly a massive white, pink, light-green, and light-brown, bentonitic claystone and siltstone containing beds of sandstone and channel deposits of sand.

The Arikaree Group in the study area was deposited during the Oligocene and Miocene. In a study conducted immediately to the west in Todd County, Arikaree sediments were described by Carter (1998) as consisting predominantly of pinkish-tan to red, very fine- to fine-grained sandstone and siltstone. Sediments having similar lithology and appearance were encountered in test holes and wells drilled for this investigation.

The deposition of the Ogallala Group began in late Miocene to early Pliocene age and continued until late Pliocene time when the climate became more arid and up-warping of the High Plains area caused deposition to cease and erosion to begin (North Plains Groundwater Conservation District, September 10, 2002). In South Dakota, the Ogallala Group has been divided into two formations: the Valentine (the basal unit) and the Ash Hollow. The following descriptions of the Valentine and Ash Hollow Formations were determined from results of this investigation and from Collins (1958b). The Valentine Formation consists of poorly consolidated, gray to olive-green, light-tan, fine sand and silt. Local lenses of olive to greenish silty clay are also present. The Ash Hollow Formation consists of calcite- and silica-cemented, light-gray to olive-gray, fine sandstone and siltstone.

Post Ogallala sediments consist of eolian deposits and alluvium. The eolian deposits consist of wind-blown sand, which is sometimes calcareous, that is derived from the Ash Hollow and Valentine Formations. In some cases the contact between the Ogallala Group and younger sediments is not easily identified. The eolian deposits are absent in most of study area (Martin and others, 2004). Alluvium is present as fluvial flood plain and terraced sediments along the more active streams and rivers. The deposits consist of poorly sorted, often cross-bedded, gravel, sand, silt, and clay (Collins, 1958b).

Hydrogeologic Setting

The High Plains aquifer system in Tripp and Gregory Counties consists of Ogallala Group sediments, alluvium, and eolian deposits that are hydraulically connected and are under unconfined conditions. The Ogallala Group is the principal geologic unit in the High Plains aquifer and underlies the majority of the study area. The White River Group and Arikaree Group are not considered to be part of the High Plains aquifer in Tripp and Gregory Counties.

The findings of this study indicate that the thickness of the Ogallala Group in the study area ranges from 0 to about 250 feet and is primarily controlled by the morphology of the eroded pre-Ogallala surface. The greatest thickness occurs where Ogallala Group sediments have filled previously eroded drainage channels. Hydrogeologic cross sections, presented on figures 2 and 3, illustrate the subsurface of the area.

Recharge and Discharge

The High Plains aquifer in Tripp and Gregory Counties is recharged primarily by infiltration of precipitation. As stated previously, average annual precipitation from 1961 through 1990 was about 24 inches in the study area (High Plains Regional Climate Center, September 11, 2002) and mean annual evaporation in the study area as measured from class A evaporation pans is about 60 inches (Gutentag and others, 1984). A previous investigation done in the High Plains aquifer in southern South Dakota has estimated recharge from precipitation to be 1.3 to 1.8 inches per year (Kolm and Case, 1983). Precipitation reaching the water table in the High Plains aquifer is dissipated by both natural and artificial processes. The majority of the precipitation is dissipated through direct evaporation or is transpired by plants. Seepage from the aquifer through springs and to streams also occurs. Ground water discharged by artificial processes includes withdrawal of water for irrigation, domestic and public consumption, and livestock.

Saturated Thickness

In South Dakota, the High Plains aquifer, as defined in this report, includes an area of about 870 square miles. The saturated thickness of the High Plains aquifer in the study area ranges from about 0 to 190 feet. The saturated thickness differs greatly between these extremes for two reasons: (1) The contact between the Ogallala Group and the underlying Arikaree Group, White River Group, or Pierre Shale is an undulating erosional surface resulting in large variations in the thickness of the Ogallala Group as described by Gutentag and others (1984), Rahn and Paul (1975); and (2) Eolian and fluvial processes have eroded and transported away parts or all of the White River Group, Arikaree Group, Ogallala Group, and eolian deposits. The greatest saturated thicknesses, 100 to 190 feet, occur in the south-central part of Tripp County and account for about 4 percent of the areal distribution of the aquifer system in the study area (fig. 4).

Water Table

Ground water in the High Plains aquifer generally is under unconfined conditions. In the period from March 2002 through August 2003, when data for this study were collected, the depth to water in the High Plains aquifer in Tripp and Gregory Counties ranged from about 5 to 132 feet below land surface. Data collected in this study indicate a variation in water level from less than 1 foot to 6 feet (table 1). Data collected from 1978 through 2003 for selected wells show ground water fluctuations of less than 10 feet (fig. 5).

The altitude and configuration of the water table of the High Plains aquifer in the study area are shown on figure 4. The configuration and slope of the water table are similar to the configuration and slope of the land surface.

Water Quality

To evaluate ground water quality of the High Plains aquifer in Tripp and Gregory Counties, water properties and chemical constituents were analyzed in water samples from nine monitoring wells installed for this study and five wells which are part of the Statewide Ground Water Quality Monitoring Network. All 14 wells are completed in the High Plains aquifer.

In April 2002, July 2003, and November 2003, nine water samples were collected from monitoring wells for analysis of general inorganic chemistry. Six of the samples were also analyzed for trace metals and radionuclides. In May 2002, five water samples were collected from wells in the Statewide Ground Water Quality Monitoring Network for analysis of general inorganic chemistry. A summary of analytical results from these 14 samples is presented in table 2.

Major-ion data indicate that water in the aquifer is a calcium-bicarbonate type (fig. 6). As indicated in table 2, water collected from the monitoring wells generally is of good quality. The total dissolved solids generally range from 141 to 364 milligrams per liter (mg/L) and hardness ranges in concentration from 48 to 231 mg/L. The exception is one sample from well R20-94-41, which has a history of high concentrations of total dissolved solids (1,273 mg/L), hardness (773 mg/L), calcium, magnesium, potassium, sulfate, and nitrate plus nitrite. Concentrations of nitrate plus nitrite are generally less than the South Dakota Drinking Water Standard of 10 mg/L, with water from 3 of 14 wells exceeding the standard. The highest nitrate plus nitrite concentration measured was 179 mg/L. All detected trace elements and radionuclides were at concentrations substantially less than their South Dakota Drinking Water Standard, except in the sample from monitoring well R2-2003-27, which had a gross alpha concentration of 27.9±5.0 picocuries per liter (pCi/L).

SUMMARY AND CONCLUSIONS

The purpose of this study was to investigate the hydrogeology of the High Plains aquifer in Tripp and Gregory Counties. The major water resource of these counties is ground water from the High Plains aquifer.

The surface geology of Tripp and Gregory Counties consists of marine, fluvial, and eolian deposits. The High Plains aquifer in these counties in South Dakota is comprised primarily of alluvial and Ogallala Group sediments. The bedrock sediments directly underlying the aquifer are the Arikaree Group, White River Group, and Pierre Shale.

The High Plains aquifer delineated in Tripp and Gregory Counties underlies about 870 square miles but is not continuous throughout the study area. The aquifer is thickest in south-central Tripp County and is under unconfined conditions. In the period from March 2002 through August 2003, when data for this study were collected, water level fluctuations ranged from less than 1 foot to 6 feet. Monitoring of selected wells over 25 years indicates a water level variation of less than 10 feet. Recharge to the High Plains aquifer is by infiltration of precipitation. Discharge from the High Plains aquifer is through evapotranspiration, through loss to streams and springs, and through withdrawals from domestic, public, livestock, and irrigation wells.

The quality of water in the High Plains aquifer in Tripp and Gregory Counties meets South Dakota Drinking Water Standards with the exception of nitrate plus nitrite concentrations of greater than 10 mg/L in three wells and a gross alpha concentration of greater than 15 pCi/L in a fourth well. The High Plains aquifer in the study area has a concentration of total dissolved solids ranging from 141 to 364 mg/L. Calcium and bicarbonate are the dominant ions in the ground water throughout the study area.

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